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Request for grant of a patent

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1. Your reference	P407
2. Patent application number *(The Patent Office will fill in this part)*	21 JAN 2003 0301342.2
3. Full name, address and postcode of the or of each applicant *(underline all surnaes)*	Intelligent Battery Technology Limited 16 Howard Street Middlesborough, TS1 5RA
Patents ADP number (if you know it)	08548898001
If the applicant is a corporate body, give the country/state of its incorporation	England & Wales
4. Title of the invention	Detection and indicating means for a storage battery
5. Name of your agent *(if you have one)*	Alistair Hamilton
"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	Tŷ Eurgain, Cefn Eurgain Lane Rhosesmor, Nr. Mold Flintshire, North Wales, CH7 6PG
Patents ADP number *(if you know it)*	07603830001

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Country	Priority Application Number *(if you know it)*	Date *(day/month/year)*

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Number of earlier application	Date of filing *(day/month/year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
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Yes

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9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document.

Continuation sheets of this form	
Description	12
Claim(s)	4
Abstract	1
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11. I/We request the grant of a patent on the basis of this application

Signature Date

21 January 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

Alistair Hamilton

01352 840891

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Detection and indicating means for a storage battery

This invention relates generally to condition detection and indicating means for an electrical storage battery. Particular embodiments of this invention also provide a storage battery having condition detection and indicating means integrally assembled thereto.

Electrical storage batteries are in widespread use. Such batteries are used in a wide range of applications including but not limited to automotive, powerboat, lighting, uninterruptible power supply (UPS) devices, and so forth.

It is of prime importance to appreciate the distinction between the condition of a battery and the state of charge of a battery. A battery can be in excellent condition and fully discharged. Likewise, a battery in poor condition can be fully charged. The definition of the condition of a battery is dependent upon its application. For example, the condition of a battery used to start an internal combustion engine might be defined as the ability of the battery to supply a large current to the starter motor. Instantaneously, such a load is an almost short-circuit on the battery. (This current is conventionally designated CCA, standing for cold-cranking amperage.) As applied to a UPS, the condition may be defined as the total energy that can be provided by the battery when fully charged. In both of these cases, the condition of the battery will deteriorate as the battery ages due, for example, to loss of conductive area in the battery plates. However, in neither case will the deterioration be reflected in the output of a conventional voltmeter. A voltmeter records only the open-circuit voltage of the battery; a property that can remain substantially unchanged until the battery is close to total failure. Likewise, monitoring the density (specific gravity) of the electrolyte can yield only limited information, and in many cases, ongoing deterioration of the condition of the battery will not cause the specific gravity of the electrolyte to change.

Conventionally, the energy-storage capacity of a battery has been measured by fully charging the battery and then discharging it through a resistive load. This is a procedure that is time-consuming, that is potentially harmful to the battery, and that requires the battery to be taken out of service. This latter point ensures that such testing is rarely performed on a battery that is required for use, for example, in a vehicle.

An integrally assembled monitoring device to measure the operating condition of a storage battery has also been proposed before. For example, US-A-5 841 357 describes a battery electrolyte monitor that includes a one-piece monitor having a probe housing with its associated circuitry and connecting leads. The connecting leads may be permanently or temporarily attached to the battery electrical output. After removing the battery filler cap, the probe is inserted into the filler cap opening on the battery. The monitor's electrolyte level indicator provides an indication of the electrolyte level. If the indicator does not illuminate, electrolyte must be added to the battery. In another example, US-A-4 913 987 describes a replacement for a conventional battery filler cap with a cap and a single wire and a sensor probe. Externally mounted circuitry monitors the voltage of the probe when it is immersed in the electrolyte. If the probe voltage drops below a predetermined value, the externally mounted monitor flashes an LED.

Limitations on the accuracy and convenience of such known methods are apparent. None satisfactorily measures the CCA, nor the energy storage capacity of the battery. There may be instances where most of the battery cells are in good working condition and only one or two are not. If it happens that such a measurement and monitoring device operates on a good cell, then the actual working capacity of the battery will be misinterpreted.

Given the limitations of known devices, there is a demand for a detecting and monitoring device for use with a storage battery to assist a user in determining the condition of the battery in an easy and most efficient manner. There is also a demand for a detecting and monitoring device that is also capable of monitoring the condition of the charging system to which a battery is connected.

An aim of this invention is to offer a solution to the limitations described above.

It is proposed that apparatus is provided for connection to a storage battery (optionally provided integrally with the battery) that measure and indicate the internal impedance of the battery. It is the internal impedance that is predominantly determinative of the CCA. The apparatus preferably also measures and indicates the potential across its terminals in a manner that appears continuous to a user.

From a first aspect, this invention provides apparatus for monitoring the condition of a storage battery comprising first and second connection conductors each for connection to a respective output terminal of the battery, switching means connected in series with a resistance between the connection conductors and voltage measurement means connected in parallel with the resistance, in which the switching means operates to complete the circuit to allow current to flow between the battery terminals, and voltage measurement means being operative to measure the potential across the resistance during such current flow, the period during which the switching means is closed and the frequency of such closures being such that the power dissipated by the apparatus averaged over several closures being substantially less than the instantaneous power delivered by the battery.

From the voltage measurements, the current can be determined using Ohm's law (current = voltage / resistance). By ensuring the period of current flow is suitably small and their frequency is suitably low, the apparatus need not be constructed to dissipate high power, nor will the battery be noticeably discharged by the action of the apparatus.

Advantageously, the resistance of the apparatus while the switching means is closed is of the same order (and preferably almost equal to) the load of minimum resistance that the battery is intended to power. For example, where the battery is a starter battery, the resistance of the apparatus may be similar to the resistance of a motor when the motor is in a stalled or full-load condition. In such a condition, the instantaneous current through the apparatus will be approximately the actual CCA of the battery.

In a typical lead acid battery, there is at least a pair of positive and negative internal plates made of lead or an alloy of lead or other metals, the plates within each pair being separated by plate separator. These plates have their own internal resistance associated with it and a good battery will have a substantially low resistance whereas a bad battery

will have a high resistance (commonly referred to in the field as an "abnormal internal resistance" or "AIR"). A low resistance implies a high cranking power of the battery and a high resistance implies low cranking power. Therefore, the remaining expected lifespan of the battery may be determined by calculating the discharge current and therefore the internal resistance. The calculated discharge current may then compared to preset value to determine its condition to be displayed on the display means. The preset values may be programmed or loaded into the related component in the detection and indicating means of the battery in accordance to a normal values associated with a good battery of the similar type.

In typical embodiments, the switching means incorporates a semiconductor switching device, such as a MOSFET or a bipolar transistor. While it may at first sight appear to be at best foolhardy to short-circuit a lead-acid battery through a transistor, provided that the current pulses are sufficiently short, insufficient energy will be dissipated within the device to cause it harm. The inventor has found that this allows a device of very surprisingly small size to be used given the instantaneous magnitude of the current. The switching device may be controlled by an output from a microcontroller.

The resistance of a storage battery in good condition is often very low. For example, in the case of a typical car battery, the resistance may be as low as 0.002Ω to 0.005Ω per cell, giving a total of approximately 0.01Ω to 0.03Ω. Therefore, care must be taken to ensure that the resistance of apparatus embodying the invention is sufficiently low that its resistance does not significantly reduce the current flowing from the battery. In particular, conductors that connect the apparatus to the battery must be of sufficiently low resistance so a not to dominate the resistance of the battery. In this regard, embodiments of the invention may conveniently be incorporated within the case of the battery itself. In such embodiments, the apparatus can be calibrated for use with the particular battery during manufacture. Alternatively, the apparatus may be configured to be suitable for external connection to an existing battery.

The indicating means is preferably of a type that is convenient to refer to, i.e. capable of indicating whether the battery is in good working condition or not while the engine is not running, and whether or not the charging system of the vehicle is in good working condition while the engine is in operation. Use of LEDs is preferred for the indicating

means along with other suitable indicators known in the art. Convenience in usage, accuracy in assessing the actual capacity of the storage battery and the ability to assess the condition of its charging system along with other benefits are some of advantageous that could be acquired through the present invention. Embodiments of the invention may alternatively or additionally be configured to provide a display of battery condition within the cabin of a vehicle to which a battery is fitted. Such embodiments may provide display hardware, for example, including several status LEDs. Alternatively, it may interface with a control and instrumentation system of the vehicle to provide a display integrated within the vehicle's instrumentation system. Such latter embodiments may interface with the vehicle's electronics through a industry standard interface.

Accordingly, it is the aim of the invention to provide a storage battery that is provided with an integrated detection and indication means to continuously monitor the actual capacity and the expected remaining life-span of the battery.

From another aspect, the invention provides a storage battery (1) having detection and indicating means integrally assembled on it, comprising;

a casing (2) having an upper portion (4) and a lower portion (5), at least a cell defined within the casing (2);

a cover (3) enclosing the upper portion (4) of the casing (2);

a pair of terminals (6) mounted on the cover, each terminal is electrically connected to the corresponding anode and cathode of the cell;

characterised in that,

the detection and indicating means includes an electronic circuit, the electronic circuit being adapted to measure the internal resistance of the storage battery and the electromotive force between the pair of terminals (6), and from the measurements, compare the measured electromotive force with a pre-determined value set in the electronic circuit and calculate the current, whereby the calculated current correspondingly indicates the expected remaining life-span of the storage battery and

the measured electromotive force indicates the condition of the storage battery based on the preset value on a display means (9).

Preferably, the detection and indicating means is configured as an electronic circuit.

Preferably, the electronic circuit is to be assembled and embedded within the cover of the storage battery.

Also preferably, an optional communication means is provided to transmit logical signals generated by the electronic circuit to a remote display means. The generated signals may also be used as source for further processing by the engine management system of the vehicle.

It is also preferable that the battery is also provided with a collapsible carrying handle.

Yet, it is also preferable that the display means include use of a light emitting diode, a bar display device or a segmented display device, which can optionally display icons to indicate the status of the battery.

In preferred embodiments, the detection and indicating means also measures the total potential across all cells of the battery. As is well known, this measurement can be used to give an indication of the state of charge of the battery.

Embodiments of the invention will now be described in detail, by way of example, and with reference to the accompanying drawings, in which:

Figure 1 is perspective view of a storage battery embodying the invention;

Figure 2 is a perspective view of another storage battery embodying the invention;

Figure 3 is a diagrammatic representation of a storage battery having an integrally assembled capacity detection and indicating means embodying the invention;

Figure 4 shows the characteristic of electromotive force waveform in a vehicle battery during different vehicle engine conditions; and

Figure 5 is another diagrammatic representation of the battery embodying the invention together with its charging system.

Figure 1 shows a perspective view of a storage battery as proposed by the present invention having integral apparatus for monitoring its condition. Generally, the battery (1) comprises of a casing (2) and a cover (3). The casing further comprises of an upper portion (4) and a lower portion (5). An upwardly extending internal wall (not shown) rises from the lower portion (5) to define an adjacently located cell (not shown). A single-cell type battery may also be possible. Normally, for automotive applications, a six-cell battery is common for a normal 12V storage battery. Positive and negative terminals (6) are also disposed on the cover. The terminals are correspondingly connected to each of the cells anode and cathode to provide the required voltage for the battery. The cover (3) may also be provided with a total of six inlet means (not shown), each inlet means correspond to each battery cell and the inlet means is used for filling or topping-up of electrolyte for the battery or, even an integrated unified venting assembly (also not shown) may also be used to provide a substantially maintenance-free battery. A handle (7) is pivotally mounted to the cover and the handle is capable of being folded or unfolded from its resting position. The handle is also capable of being flipped to its either side and to rest on the guide (not shown). The handle allows for one-handed operation for lifting of the battery is also anticipated.

As shown in Figure 2, the battery terminals (6) are disposed on the lowered section (8) of the cover (3) for a DIN (European) standard type battery. Such arrangement is particularly adapted for providing flush mounted battery terminals, which reduces possibility of a short circuit occurring if it happens that the bonnet of the vehicle comes into contact with the battery, for example, as the result of an accident. Alternatively, the terminals may also be mounted to the cover forming a raised terminal as commonly found on JIS (Japan) compliance battery, as shown in Figure 1. To eliminate the likelihood of a short circuit, the terminals might also be slightly shortened. A display means (9), is also provided on the cover, such display means is advantageously used to display the condition and actual capacity of the battery. Such a display means (9) would also help to display whether the battery is being charged sufficiently by the vehicle charging system while the engine is running. In effect, the system could also be

used to monitor the charging pattern of the charging system during engine operation. Further, it is also able to detect whether there is any leakage is present in the electrical system to indicate that this has occurred. Normally, if the battery were not being charged sufficiently, then it could be presumed that the alternator of the vehicle is at fault or there is a fault in other components within the charging system. An electronic circuit capable of delivering such advantageous features is preferably assembled and embedded within the battery cover (3). The circuit operation will be discussed in detail later. An optional communication port (17), preferably to generate output signals according to the one of the CAN communication protocols (e.g. I^2CAN), is also provided on the cover (Figure 1, Figure 2). In this Figure 2, the handle for lifting the battery is not shown.

Now referring to Figure 3, there is shown the diagrammatic representation (not to scale) of a battery embodying the invention having such an electronic circuit. As indicated earlier, the circuit is preferably embedded within the cover (3), mainly for its space saving and compactness. The display means (9) may includes use of a light emitting diode (LED), segmented display device, a bar display or any other suitable device, optionally capable of displaying icons, known to those skilled in the technology. The display means is also preferably flush mounted to the cover so that it is flatly mounted to the same. If an LED is to be used, then preferably, at least three different illumination modes are provided. For example, the LEDs may be of different colours, such as the red, yellow and green LEDs as depicted in Figures 1 and 2. Such three different colours of illumination correspond to three different levels of measured electromotive force available in the battery. While the engine is not running or during a low electrical load, a high potential across the terminals in a good condition battery will illuminate one of the LEDs, usually the yellow LED. Such high potential would be between 12.0 to 13.5 volts. If the red LED illuminates, then this indicates that the battery is either weak or there is some electrical leakage in the system. The electromotive force of a weak battery may be below 12.0 volts, depending upon the nature of the problem with the battery. If the battery is found to be in a good condition and yet the red LED still illuminates, it may mean that leakage in the electrical system causes the battery to be self-discharging or discharged by external components of the vehicle. This indicates that remedial action must be taken if problems are to be avoided.

While the engine is running, the system is used to detect and monitor the condition of the charging system. In particular, a fully operational charging system will illuminate the green LED because the illumination of such LED is set at above 13.6 volts. If for some reason or another, the other LED were illuminated, then it would indicate that the charging system is at fault. It may mean that the alternator is incapable of charging the battery or there is a component fault in the system. As such, the charging pattern of the charging system could also be indicated on the display means. Moreover, a segmented display device capable of exhibiting the actual reading of the measured electromotive force could also be used along with bar or icon display that correspond to the actual measured electromotive force in the battery.

To illustrate how such values are set as references to indicate the actual condition of the battery and its charging system, reference is now made to Figure 4, where the figure shows a characteristic waveform of the electromotive force in a good and fully operational storage battery during different stage of engine operation. For instance, while the ignition key is in the off position (A) or during open circuit or low load conditions, the potential across the terminals would normally be nearly 13.2 volts, particularly just after the battery had been charged or after engine running. When the ignition is switched on (B), the voltage will drop to about 12.3 volts. Therefore, a storage battery that is in good condition would normally have between 12.3 to 13.2 volts of potential across the terminals. In such a situation, the yellow LED will be illuminated, because the yellow LED is set at such voltage range to be energised. During starting of the engine (C), the voltage across the terminals may drop to as low as 9.0 volts and then rise steadily to about 15.5 volts once the engine starts, depending on the ambient temperature. It will then slowly drop to about 14.0 volts (D). It will remain more or less at this level during subsequent engine operation. In that condition, the battery is being charged by the charging system and the green LED will be illuminated to indicate that this is the case. (All of these voltages are subject to change to meet with the requirements of different manufacturers.)

Referring back to Figure 3, the operation of the electronic circuit will now be explained. The circuit includes a regulated 5 volts power section (11) to energise the circuit, a voltage and impedance reference section (12), an analogue-to-digital converter (13), a

clock signal generator (14), a microcontroller (15), a decoder (16) and the display means (9). A communication protocol stage (17), preferably using the CAN bus communication protocol, is also optionally provided to the circuit to transmit the processed signal to a remotely connected display panel or to the engine management system. The microcontroller (15) is used to process measured electromotive force and the internal resistance of the battery in digital form, calculate the current and compare it with that of a predetermined values set in the microcontroller so as to provide the previously described details.

The associated parameters available in the battery will be represented as voltage and impedance values across the terminals. The impedance is derived from measurement of the maximum current that is produced by the amplifier when a low resistance is momentarily connected across the battery terminals. This voltage is amplified by the operational amplifiers (18, 19) in the analogue domain.

The analogue signals from such amplification are then converted into digital signals by the analogue-to-digital converter (13). In order to keep the length of the current pulse suitably short, the analogue-to-digital converter may complete its voltage measurement over several successive pulses, a sub-range of the total voltage range being scanned during each pulse.

The microcontroller computes and processes digital signals from the analogue-to-digital converter (13), and based upon the measured voltage, the microcontroller provides an output that selectively energises the corresponding display means. The microcontroller includes a microprocessor, memory unit and an input/output. The predetermined values of reference voltages and current associated with a good battery of the similar type as discussed earlier are set in the microcontroller itself through its operating software. A clock signal is provided by the clock signal generator (14), which preferably includes of a crystal oscillator for its inherent stability. The decoder (16) is used to decode logical data signals output from the microcontroller (15) to drive the display means (9) such that the illumination of the display means corresponds to the actual condition of the battery and the charging system as discussed above. As also indicated earlier, communication between the electronic circuit of the battery and a remote display panel or engine management unit is made possible via an optional I2C bus communication

port which is preferably provided on the side of the storage battery. Such optional communication feature provides further convenience to the user, because the condition of the battery, by way of the display means, may be exhibited on the vehicle dashboard or at any other suitable location.

Following starting of the engine, the battery is recharged to replace energy drawn from it during starting or operation of electrical components of the vehicle prior to starting the engine. It is desirable that this charging process takes place as quickly as possible, yet must not be so fast that the current flowing within the battery will cause it damage. The current and voltage are controlled by the regulator pack associated with the vehicle's alternator. The regulator pack uses a sensor line that is connected to the battery to monitor the battery voltage. In a modification to the invention, the apparatus provides a connection to which the sensor line is connected. By adjusting the voltage that is applied through the connection to the sensor line, the apparatus can control the output of the alternator. If the apparatus reduces the voltage in the sensor line, the regulator pack treats this as if it were a reduction in the battery voltage, and will raise its output to compensate. Contrarily, if the apparatus increases that voltage, then the alternator will reduce its output because it will receive a sensing signal that is equivalent to a high battery voltage.

It will be readily apparent that a storage battery constructed as an embodiment of the present invention is convenient to use and its operational life might even be extended due to the continuous monitoring. This is in particularly the case if a fault were to occur because appropriate rectification measures may be taken promptly before any damage is done to the battery.

Figure 5 shows yet another diagrammatic representation of a battery that is connected to its charging system and in particular, the charging system of the vehicle where such battery is used. Further, as it can be seen in the drawing, a switch (20) is also included in the circuit to allow selective actuation of the detection and indicating means. Preferably, the switch is only actuated once the battery has been installed on the vehicle. This is in particular to reduce the possibility of energy being drained from the battery during its transport or storage. During engine operation, the charging system that normally includes an alternator (21), a full-wave rectifier (22) and voltage regulator (not

shown) would generate at least 13.6 volts across the battery terminals. In this situation, the green LED is illuminated to indicate that the charging system is fully-operational as indicated earlier. Any lower potential from the charging system would be detected by the system and indicated as a fault by illumination of one of the LEDs as discussed above. Low potential is well-recognised as being an indication of an immediate problem with the state of charge of the battery, but, as the inventor has determined, does not give an indication of the health or expected lifespan of the battery, which is determined by measurement of the internal resistance, as discussed above. Thus, it will be seen that embodiments of the invention can provide both an indication of the immediate state of charge of the battery and an associated charging system, as well as its state of health and longer-term condition.

While the preferred embodiments of the present invention have been described, it should be understood that various changes, adaptations and modifications may be made thereto within the scope of the claims. For example, instead of an LED display, an LCD system may be used. This might, for example, display icons to indicate the status of the battery.

Claims

1. Apparatus for monitoring the condition of a storage battery comprising first and second connection conductors each for connection to a respective output terminal of the battery, switching means connected in series with a resistance between the connection conductors and voltage measurement means connected in parallel with the resistance, in which the switching means operates to complete the circuit to allow current to flow between the battery terminals, and voltage measurement means being operative to measure the potential across the resistance during such current flow, the period during which the switching means is closed and the frequency of such closures being such that the power dissipated by the apparatus averaged over several closures being substantially less than the instantaneous power delivered by the battery.

2. Apparatus according to claim 1 in which the switching means includes a solid-state switching device.

3. Apparatus according to claim 2 in which the gate of the solid-state switching device is controlled by an output of a microcontroller.

4. Apparatus according to claim 1 or claim 2 in which the solid-state switching device is a MOSFET.

5. Apparatus according to claim 1 or claim 2 in which the solid-state switching device is a bipolar transistor.

6. Apparatus according to any preceding claim that comprises an amplifier to amplify the voltage that appears across the resistance.

7. Apparatus according to any preceding claim comprising an analogue-to-digital converter to measure the voltage that appears across the resistance.

8. A storage battery (1) having detection and indicating means integrally assembled on it, comprising

a casing (2) having an upper portion (4) and a lower portion (5), at least a cell defined within the casing (2);

a cover (3) enclosing the upper portion (4) of the casing (2);

a pair of terminals (6) mounted on the cover, each terminal is electrically connected to the corresponding anode and cathode of the cell;

characterised in that,

the detection and indicating means includes an electronic circuit, the electronic circuit being adapted to measure the internal resistance of the storage battery and the electromotive force between the pair of terminals (6) and compare the measured electromotive force with a pre-determined value set in the electronic circuit and calculate the current, whereby the calculated current correspondingly indicates the expected remaining life-span of the storage battery and the measured electromotive force indicates the condition of the storage battery based on the preset value on a display means (9).

9. A storage battery according to claim 8, further characterised in that the current is calculated using a preset voltage associated with the storage battery.

10. A storage battery according to claim 8 or claim 9, further characterised in that the electronic circuit is also adapted to compare the measured electromotive force to the predetermined value thereby indicating the condition of a charging system where the battery is connected.

11. A storage battery according to claim 10, further characterised in that the electronic circuit is adapted to process the measured electromotive force and the internal resistance of the battery and on the display means (9), indicate at least, whether the battery is in good working condition or, the battery is not

in good working condition or, whether the battery is being charged sufficiently by the charging system.

12. A storage battery according to claim 11, further characterised in that the electronic circuit includes use of a microcontroller (15) to process the measured electromotive force and the internal resistance of the storage battery.

13. A storage battery according to claim 12, further characterised in that the electronic circuit also includes use of a regulated power source (11), a reference voltage and impedance (12), an analogue-to-digital converter (13), a clock signal generator (14), a decoder (16) and the display means (9).

14. A storage battery according to any preceding claim further characterised in that the electronic circuit further includes a communication means (17) to transmit the processed signal to other display means remotely position from the storage battery.

15. A storage battery according to claim 14, further characterised in that the display means (9) includes a light emitting diode or a liquid crystal display device.

16. A storage battery according to claim 15, further characterised in that the display means is mounted flush with the cover (3).

17. A storage battery according to claims 15 or 16, further characterised in that the display means (9) includes a segmented display device for exhibiting a measured value.

18. A storage battery according to claims 15 to 17 in which the display device is capable of displaying one or more icons to indicate the state of the battery.

19. A storage battery according to any preceding claim, further characterised in that the electronic circuit is assembled and embedded within the cover (3).

20. A storage battery according to any preceding claim, further characterised in that a handle (7) is pivotally mounted and positioned substantially at the centre of the cover (3) for assisting lifting of the battery.

21. A storage battery according to claim 20 in which the handle is collapsible.

22. A storage battery according to any preceding claim, further characterised in that the storage battery is used in a motor vehicle, and the display means is adapted to indicate the condition of the battery during the engine off and indicate the condition of the charging system of the motor vehicle when the engine is in operation.

23. A storage battery according to any preceding claim further characterised in that the electronic circuit also capable of detecting leakage of energy from the battery and indicating the same on the display means while the engine is not running.

24. A storage battery according to any preceding claim in which the detection and indicating means measures the total potential across all cells of the battery and the internal resistance of the storage battery.

Abstract

Storage battery with detection and indicating means for a storage battery

There is disclosed a storage battery which is capable of self-monitoring by detecting and indicating the actual capacity and the expected remaining life-span of the battery, the condition of its charging system and the discharge level. The battery is provided with an integrally assembled detection and indicating means which measure the actual potential across its terminal (indicative of the state of charge of the battery) and the internal resistance of the battery (indicative of its health). The expected remaining life-span of the battery is derived from the calculation of current from these measurements. The battery is assembled to include a casing (2), a cover (3) and a capacity detection and indicating means. The detection and indicating means consist of an electronic circuit that measures the electromotive force and the internal resistance of the battery and indicate the same on a display means (9). The display means is adapted to exhibit whether the battery is in good working condition or otherwise during engine off or whether the charging system of the vehicle is in good working condition during engine in operation. Further, it could also monitor potential leakage presence in its electrical system.

Fig 1

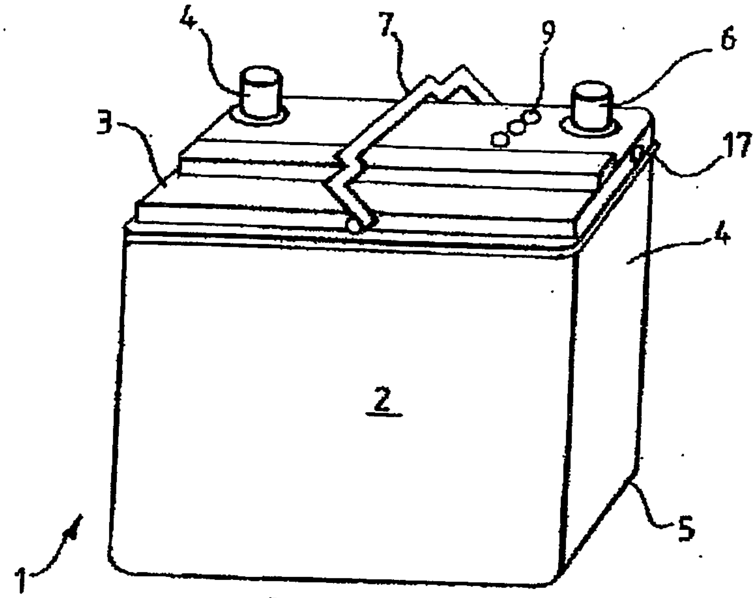

FIG.1.

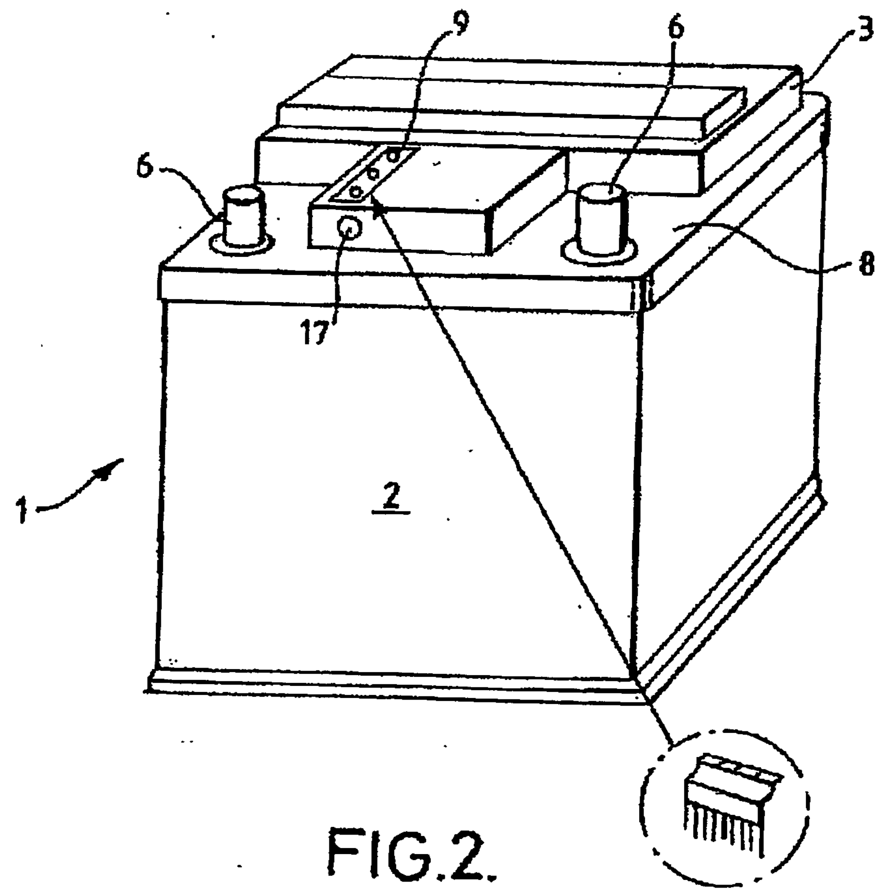

FIG.2.

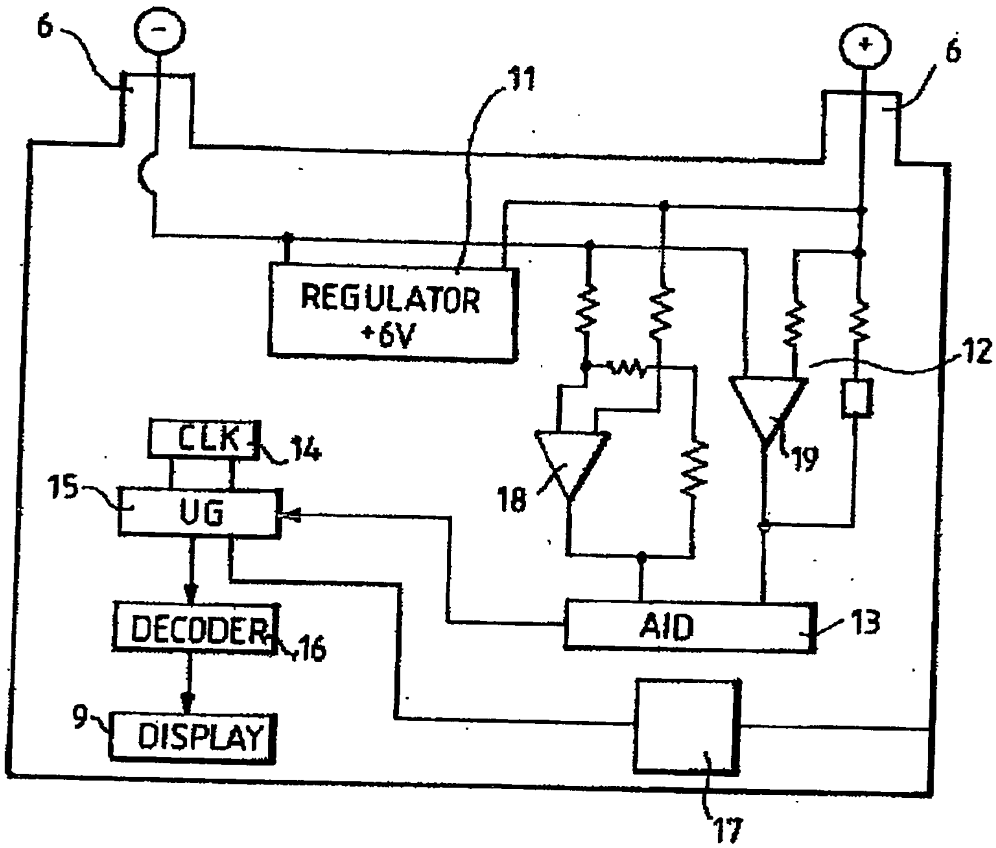
6
6
11
REGULATOR
+6V
12
CLK
14
15
UG
18
19
DECODER
16
AID
13
9
DISPLAY
17

FIG.3.

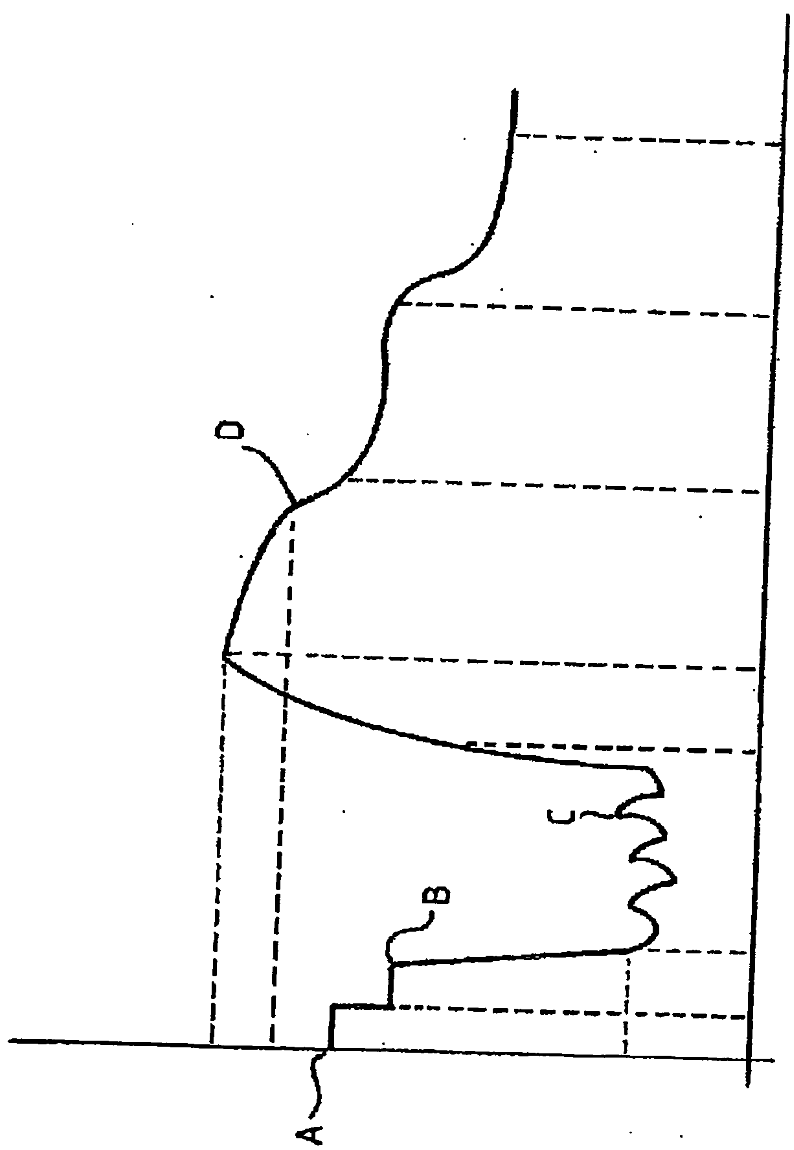

FIG.4.

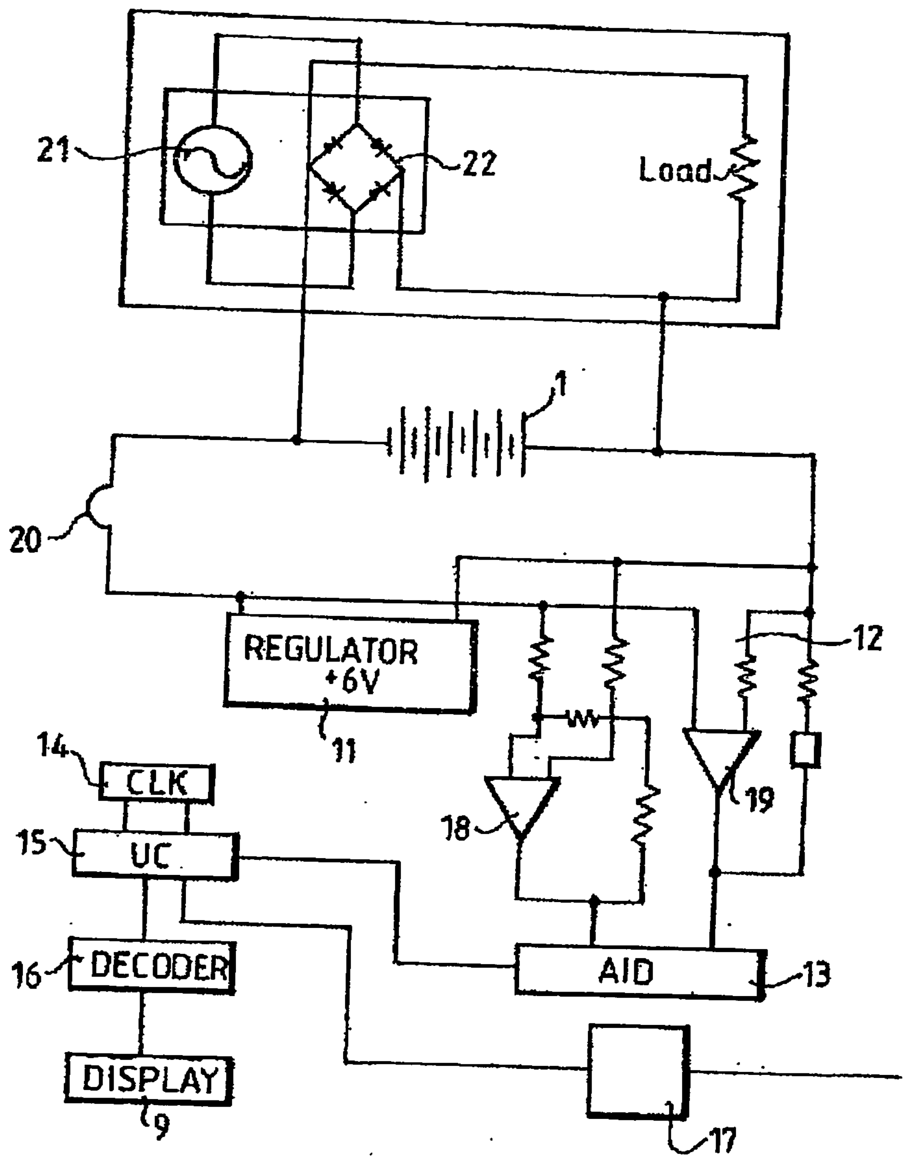
21
22
Load
1
20
REGULATOR
+6V
11
12
14
CLK
15
UC
18
19
16
DECODER
AID
13
DISPLAY
9
17

FIG.5.

PCT Application
PCT/GB2004/000194